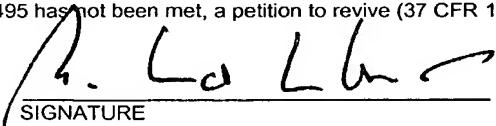


FORM PTO-1390 (REV. 5-93)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER 10191/2328
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 10/089395
INTERNATIONAL APPLICATION NO. PCT/DE00/03416	INTERNATIONAL FILING DATE 28 September 2000 (28.09.00)	PRIORITY DATE CLAIMED: 30 September 1999 (30.09.99)
TITLE OF INVENTION DATA TRANSMISSION METHOD		
APPLICANT(S) FOR DO/EO/US Frank KOWALEWSKI		
<p>Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.</p> <p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <ol style="list-style-type: none"> <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). <input checked="" type="checkbox"/> has been transmitted by the International Bureau. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US) <p>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <ol style="list-style-type: none"> <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). <input type="checkbox"/> have been transmitted by the International Bureau. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. <input checked="" type="checkbox"/> have not been made and will not be made. <p>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) (unsigned).</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p> <p>Items 11. to 16. below concern other document(s) or information included:</p> <p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</p> <p>14. <input checked="" type="checkbox"/> A substitute specification.</p> <p>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>16. <input checked="" type="checkbox"/> Other items or information: International Search Report (translated), Preliminary Examination Report and PCT/RO/101.</p>		

EXPRESS MAIL NO.: E1003625990US

U.S. APPLICATION NO. if known, see 37.C.F.R.1.5	INTERNATIONAL APPLICATION NO. PCT/DE00/03416	ATTORNEY'S DOCKET NUMBER 10191/2328			
17. <input checked="" type="checkbox"/> The following fees are submitted: Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EUROPEAN PATENT OFFICE or JPO \$890.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) \$710.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$740.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$1,040.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$100.00		CALCULATIONS PTO USE ONLY			
ENTER APPROPRIATE BASIC FEE AMOUNT =		\$ 890			
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		\$			
Claims	Number Filed	Number Extra	Rate		
Total Claims	8 - 20 =	0	X \$18.00	\$ 0	
Independent Claims	1 - 3 =	0	X \$84.00	\$ 0	
Multiple dependent claim(s) (if applicable)		+ \$280.00	\$		
TOTAL OF ABOVE CALCULATIONS =		\$ 890			
Reduction by $\frac{1}{2}$ for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).		\$			
SUBTOTAL =		\$ 890			
Processing fee of \$130.00 for furnishing the English translation later the <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).		\$			
TOTAL NATIONAL FEE =		\$ 890			
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property		\$			
TOTAL FEES ENCLOSED =		\$ 890			
		Amount to be: refunded	\$		
		charged	\$		
a. <input type="checkbox"/> A check in the amount of \$ _____ to cover the above fees is enclosed.					
b. <input checked="" type="checkbox"/> Please charge my Deposit Account No. <u>11-0600</u> in the amount of \$890.00 to cover the above fees. A duplicate copy of this sheet is enclosed.					
c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>11-0600</u> . A duplicate copy of this sheet is enclosed.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
 SIGNATURE					
Richard L. Mayer, Reg. No. 22,490 NAME					
3/29/02 DATE					
SEND ALL CORRESPONDENCE TO: Kenyon & Kenyon One Broadway New York, New York 10004					
Customer No. 26646					

10/089395
JCTO Rec'd PCT/P10 29 MAR 2002
[10191/2328]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) : Frank KOWALEWSKI
Serial No. : To Be Assigned
Filed : Herewith
For : DATA TRANSMISSION METHOD
Art Unit : To Be Assigned
Examiner : To Be Assigned

Assistant Commissioner
for Patents
Washington, D.C. 20231
Box Patent Application

PRELIMINARY AMENDMENT AND
37 C.F.R. § 1.125 SUBSTITUTE SPECIFICATION STATEMENT

SIR:

Please amend the above-identified application before examination, as set forth below.

IN THE SPECIFICATION AND ABSTRACT:

In accordance with 37 C.F.R. § 1.121(b)(3), a Substitute Specification (including the Abstract, but without claims) accompanies this response. It is respectfully requested that the Substitute Specification (including Abstract) be entered to replace the Specification of record.

IN THE CLAIMS:

On the first page of the claims, first line, change "What is claimed is:" to:

--What Is Claimed Is:--.

Please cancel original claims 1 to 8, without prejudice, in the underlying PCT Application No. PCT/DE00/03416.

Please add the following new claims:

9. (New) A data transmission method, comprising:
 - transmitting a data signal between a transmitter and a receiver as a data stream of data bursts in at least a first transmission mode and a second transmission mode;
 - in the first transmission mode, transmitting a reference signal by the transmitter in each data burst, the reference signal being evaluated in the receiver; and
 - in the second transmission mode, avoiding transmitting the reference signal by the transmitter in each data burst and instead transmitting additional redundancy data of the data signal in each data burst.
10. (New) The method according to claim 9, wherein:
 - the additional redundancy data are provided by data of the data signal that are transmitted in repetition.
11. (New) The method according to claim 10, wherein:
 - the data transmitted in repetition are received in repetition by the receiver and are evaluated separately in the receiver.
12. (New) The method according to claim 11, further comprising:
 - selecting for at least one of further processing and delivery to a user a data version of the data transmitted in repetition having a larger received signal.
13. (New) The method according to claim 9, further comprising:
 - in the second transmission mode, eliminating interference in the transmitter.
14. (New) The method according to claim 9, further comprising:
 - transmitting a plurality of data streams simultaneously according to a CDMA technique.

15. (New) The method according to claim 9, wherein:

the data bursts have at least two data blocks, between which a block is arranged which is used, in the first transmission mode, for the reference signal, and which is used, in the second transmission mode, for the additional redundancy data.

16. (New) The method according to claim 9, further comprising:

selecting a data format for the data signal to be transmitted in both the first transmission mode and the second transmission mode so as to be identical.

Remarks

This Preliminary Amendment cancels original claims 1 to 8, without prejudice, in the underlying PCT Application No. PCT/DE00/03416. The Preliminary Amendment also adds new claims 9-16. The new claims conform the claims to U.S. Patent and Trademark Office rules and do not add new matter to the application.

In accordance with 37 C.F.R. § 1.121(b)(3), the Substitute Specification (including the Abstract, but without the claims) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and Abstract to U.S. Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. § 1.121(b)(3)(iii) and § 1.125(b)(2), a Marked Up Version Of The Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. Approval and entry of the Substitute Specification (including Abstract) are respectfully requested.

The underlying PCT Application No. PCT/DE00/03416 includes an International Search Report, dated March 20, 2001, and an International Preliminary Examination Report, dated January 17, 2002, copies of which are submitted herewith.

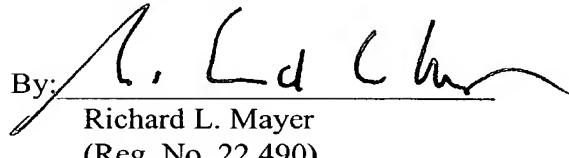
Applicant asserts that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully Submitted,

KENYON & KENYON

Dated: 3/29/02

By:



Richard L. Mayer
(Reg. No. 22,490)

One Broadway
New York, NY 10004
(212) 425-7200

DATA TRANSMISSION METHOD

Field Of The Invention

The present invention relates to a data transmission method in which a data signal is transmitted between a transmitter and receiver in the form of a data stream of data bursts in at least two transmission modes, in the first mode a reference signal being transmitted by the transmitter in each data burst, and in the second mode no reference signal being transmitted by the transmitter in each data burst.

Although applicable in principle to any data transmissions, the present invention and the problem underlying it are described with reference to a cellular CDMA data transmission system (CDMA = Code Division Multiple Access), which uses both a transmission mode which requires the transmission of a reference signal as well as one which does not require a reference signal.

Background Information

In transmitting data over multipath channels, the transmitted data symbols create interference at the receiver. The interference can be eliminated in the receiver if the pulse response of the channel is known, such as can be inferred from K. D. Kammeyer, "Communication Transmission," Second Edition, Information Technology Series, Teubner, Stuttgart, 1996, and from A. Klein, G.K. Kaleh, and P.W. Baier, "Zero Forcing and Minimum Mean-Square-Error Equalization for Multiuser Detection in Code Division Multiple Access Channels," IEEE Transportation Vehicle Technology, Volume 45 (1996), 276-287. The channel pulse response can be computed, e.g., in the receiver from a received reference signal.

However, interference can also be eliminated in the transmitter if the channel pulse responses are known there. Then the channel pulse response no longer needs to be computed in the receiver. In other words, transmission of a reference signal is then not necessary.

It is also possible to combine transmission systems that have interference elimination in the receiver and systems that have elimination in the transmitter, as is known from Bosch, "Mixed Use of Joint Predistortion and Joint Detection in the UTRA TDD mode," ETSI Tdoc SMG2 UMTS-L1 205/98.

5

Because in data transmission systems that support interference elimination both in the receiver and in the transmitter the transmitted reference signal is superfluous when elimination is performed by the transmitter, the transmitted reference signal then occupies transmission capacity unnecessarily. If, when elimination is performed by the transmitter, an individualized transmission format is used, then the corresponding transmission devices are more complex (e.g., as a result of the channel coding designs that become necessary) and/or the data services of the two transmission modes are different.

Summary Of The Invention

15

The idea underlying the present invention is that the data format for the data to be transmitted in both transmission modes is advantageously selected so as to be identical, and in the mode which does not require a reference signal, in place of this signal, additional redundancy of the data is transmitted.

20

The method according to the present invention has the particular advantage that an improvement of the radio link can be achieved in the mode in which no reference signal is required, and moreover at very small additional expense.

25

According to one preferred refinement, the redundancy data transmitted in place of the reference signal are provided through data of the data signal that are transmitted in repetition.

According to another preferred refinement, the data transmitted in repetition are received by the receiver in repetition and are evaluated in the receiver separately.

30

According to another preferred refinement, the data version of the data transmitted in repetition having the larger receiving signal is selected for further processing and/or for delivery to the user.

5 According to another preferred refinement, in the second mode, interference is eliminated in the transmitter.

According to another preferred refinement, a plurality of data streams are transmitted simultaneously according to the CDMA method.

10

According to another preferred refinement, the data bursts have at least two data blocks, between which a block is arranged, which in the first mode is used for the reference signal and in the second mode is used for the redundancy data.

15 According to another preferred refinement, the data format for the data signals to be transmitted is selected in both transmission modes so as to be identical.

Brief Description Of The Drawings

20 Figure 1a depicts a first block diagram of a burst structure to explain a specific embodiment of the present invention.

Figure 1b depicts a second block diagram of a burst structure to explain a specific embodiment of the present invention.

25

Figure 1c depicts a third block diagram of a burst structure to explain a specific embodiment of the present invention.

Detailed Description

In Figures 1a-c, B designates a data burst, t the time, DB1 a first data block, DB2 a second data block, HS an intermediate block for an auxiliary signal, RS a reference signal data block, 5 and RD a redundancy signal data block.

The burst structure according to Figures 1a-c is used in a cellular CDMA data transmission system, which operates in time duplex (TDD).

10 This system has two transmission modes:

- one mode having elimination of interference in the receiver using joint detection in accordance with the teaching of A. Klein, G.K. Kaleh, and P.W. Baier, "Zero Forcing and Minimum Mean-Square-Error Equalization for Multiuser Detection in Code Division

15 Multiple Access Channels," IEEE Transportation Vehicle Technology, Volume 45 (1996), 276-287; and

- one mode B having elimination of interference in the transmitter using joint pre-equalization.

20

The data are transmitted between transmitter and receiver in bursts B, which include in each case two data blocks DB1 and DB2 and auxiliary signal data block HS situated in between, as is illustrated in Figure 1a.

25 The data format for the data signals to be transmitted is selected in both transmission modes so as to be identical.

In mode A, in auxiliary signal data block HS, a reference signal data block RS is transmitted, which is used for computing the channel pulse response in the receiver, as is illustrated in

30 Figure 1b.

In mode B, in auxiliary signal data block HS, a reference signal data block RD is transmitted, i.e., additional data redundancy in the form of repeated data symbols, as is illustrated in Figure 1c.

5 Among the multiply transmitted data symbols, the versions having the stronger received signal are selected in the receiver and are further processed (e.g., using a channel decoding), or they are conveyed to the user.

10 Although the present invention has been described above on the basis of a preferred exemplary embodiment, it is not limited thereto, but rather can be modified in many ways.

15 In particular, the method according to the present invention can be used in all data transmission systems which use both a transmission mode which requires the transmission of a reference signal as well as a transmission mode which does not require a reference signal, and it is not limited to CDMA data transmission systems.

In addition, any criterion for the selective further processing or delivery of the redundancy data can be used.

Abstract Of The Disclosure

A data transmission method in which a data signal is transmitted between transmitter and receiver in the form of a data stream of data bursts in at least two transmission modes, in the first mode a reference signal being transmitted by the transmitter in each data burst and being evaluated in the receiver, and in the second mode no reference signal being transmitted by the transmitter in each data burst. In the second mode, in place of the reference signal, additional redundancy data of the data signal are transmitted in each data burst.

DATA TRANSMISSION METHOD

[Background Information] Field Of The Invention

The present invention relates to a data transmission method in which a data signal is transmitted between a transmitter and receiver in the form of a data stream of data bursts in at least two transmission modes, in the first mode a reference signal being transmitted by the transmitter in each data burst, and in the second mode no reference signal being transmitted by the transmitter in each data burst.

Although applicable in principle to any data transmissions, the present invention and the problem underlying it are described with reference to a cellular CDMA data transmission system (CDMA = Code Division Multiple Access), which uses both a transmission mode which requires the transmission of a reference signal as well as one which does not require a reference signal. [The background for the necessity of two modes is, e.g., as follows.]

15 Background Information

In transmitting data over multipath channels, the transmitted data symbols create interference at the receiver. The interference can be eliminated in the receiver if the pulse response of the channel is known, such as can be inferred from K. D. Kammeyer, "Communication Transmission," Second Edition, Information Technology Series, Teubner, Stuttgart, 1996, and from A. Klein, G.K. Kaleh, and P.W. Baier, "Zero Forcing and Minimum Mean-Square-Error Equalization for Multiuser Detection in Code Division Multiple Access Channels," IEEE Transportation Vehicle Technology, Volume 45 (1996), 276-287. The channel pulse response can be computed, e.g., in the receiver from a received reference signal.

However, interference can also be eliminated in the transmitter if the channel pulse responses are known there. Then the channel pulse response no longer needs to be computed in the receiver. In other words, transmission of a reference signal is then not necessary.

It is also possible to combine transmission systems that have interference elimination in the receiver and systems that have elimination in the transmitter, as is known from Bosch,
5 "Mixed Use of Joint Predistortion and Joint Detection in the UTRA TDD mode," ETSI Tdoc
SMG2 UMTS-L1 205/98.

Because in data transmission systems that support interference elimination both in the receiver and in the transmitter the transmitted reference signal is superfluous when elimination is performed by the transmitter, the transmitted reference signal then occupies
10 transmission capacity unnecessarily. If, when elimination is performed by the transmitter, an individualized transmission format is used, then the corresponding transmission devices are more complex (e.g., as a result of the channel coding designs that become necessary) and/or the data services of the two transmission modes are different.

15 [Advantages of the] Summary Of The Invention

The idea underlying the present invention is that the data format for the data to be transmitted in both transmission modes is advantageously selected so as to be identical, and in the mode which does not require a reference signal, in place of this signal, additional redundancy of the
20 data is transmitted.

The method according to the present invention [having the features of Claim 1] has the particular advantage that an improvement of the radio link can be achieved in the mode in which no reference signal is required, and moreover at very small additional expense.

25 [In the subclaims can be found advantageous refinements and improvements of the method according to the present invention indicated in Patent Claim 1.]

According to one preferred refinement, the redundancy data transmitted in place of the
30 reference signal are provided through data of the data signal that are transmitted in repetition.

According to another preferred refinement, the data transmitted in repetition are received by

the receiver in repetition and are evaluated in the receiver separately.

According to another preferred refinement, the data version of the data transmitted in repetition having the larger receiving signal is selected for further processing and/or for delivery to the user.

According to another preferred refinement, in the second mode, interference is eliminated in the transmitter.

10 According to another preferred refinement, a plurality of data streams are transmitted simultaneously according to the CDMA method.

According to another preferred refinement, the data bursts have at least two data blocks, between which a block is arranged, which in the first mode is used for the reference signal and in the second mode is used for the redundancy data.

According to another preferred refinement, the data format for the data signals to be transmitted is selected in both transmission modes so as to be identical.

20 Brief Description Of The Drawings

[An exemplary embodiment of the present invention is depicted in the drawing and is discussed in greater detail in the description below.]

25 Figure 1a [-c] depicts a first block diagram of a burst structure to explain a specific embodiment of the present invention.

~~Figure 1b depicts a second block diagram of a burst structure to explain a specific embodiment of the present invention.~~

30 ~~Figure 1c depicts a third block diagram of a burst structure to explain a specific embodiment of the present invention.~~

Detailed Description [of the Exemplary Embodiments]

In [Figure] Figures 1a-c, B designates a data burst, t the time, DB1 a first data block, DB2 a second data block, HS an intermediate block for an auxiliary signal, RS a reference signal data block, and RD a redundancy signal data block.

The burst structure according to [Figure] Figures 1a-c is used in a cellular CDMA data transmission system, which operates in time duplex (TDD).

10 This system has two transmission modes:

- one mode having elimination of interference in the receiver using joint detection in accordance with the teaching of A. Klein, G.K. Kaleh, and P.W. Baier, "Zero Forcing and Minimum Mean-Square-Error Equalization for Multiuser Detection in Code Division

15 Multiple Access Channels," IEEE Transportation Vehicle Technology, Volume 45 (1996), 276-287; and

- one mode B having elimination of interference in the transmitter using joint pre-equalization.

20

The data are transmitted between transmitter and receiver in bursts B, which include in each case two data blocks DB1 and DB2 and auxiliary signal data block HS situated in between, as is illustrated in Figure 1a.

25 The data format for the data signals to be transmitted is selected in both transmission modes so as to be identical.

In mode A, in auxiliary signal data block HS, a reference signal data block RS is transmitted, which is used for computing the channel pulse response in the receiver, as is illustrated in 30 Figure 1b.

In mode B, in auxiliary signal data block HS, a reference signal data block RD is transmitted,

i.e., additional data redundancy in the form of repeated data symbols, as is illustrated in Figure 1c.

Among the multiply transmitted data symbols, the versions having the stronger received
5 signal are selected in the receiver and are further processed (e.g., using a channel decoding), or they are conveyed to the user.

Although the present invention has been described above on the basis of a preferred exemplary embodiment, it is not limited thereto, but rather can be modified in many ways.

10

In particular, the method according to the present invention can be used in all data transmission systems which use both a transmission mode which requires the transmission of a reference signal as well as a transmission mode which does not require a reference signal, and it is not limited to CDMA data transmission systems.

15

In addition, any criterion for the selective further processing or delivery of the redundancy data can be used.

Abstract Of The Disclosure

[The present invention creates a] A data transmission method in which a data signal is transmitted between transmitter and receiver in the form of a data stream of data bursts [(B)] in at least two transmission modes, in the first mode a reference signal [(RS)] being transmitted by the transmitter in each data burst [(B)] and being evaluated in the receiver, and in the second mode no reference signal [(RS)] being transmitted by the transmitter in each data burst [(B)]. In the second mode, in place of the reference signal [(RS)], additional redundancy data [(RD)] of the data signal are transmitted in each data burst [(B)].

10

[(Figure 1)]

1/pcts

[10191/2328]

DATA TRANSMISSION METHOD

Background Information

The present invention relates to a data transmission method in which a data signal is transmitted between a transmitter and receiver in the form of a data stream of data bursts in at least two transmission modes, in the first mode a reference signal being transmitted by the transmitter in each data burst, and in the second mode no reference signal being transmitted by the transmitter in each data burst.

Although applicable in principle to any data transmissions, the present invention and the problem underlying it are described with reference to a cellular CDMA data transmission system (CDMA = Code Division Multiple Access), which uses both a transmission mode which requires the transmission of a reference signal as well as one which does not require a reference signal. The background for the necessity of two modes is, e.g., as follows.

In transmitting data over multipath channels, the transmitted data symbols create interference at the receiver. The interference can be eliminated in the receiver if the pulse response of the channel is known, such as can be inferred from K. D. Kammeyer, "Communication Transmission," Second Edition, Information Technology Series, Teubner, Stuttgart, 1996, and from A. Klein, G.K. Kaleh, and P.W. Baier, "Zero Forcing and Minimum Mean-Square-Error Equalization for Multiuser Detection in Code Division Multiple Access Channels," IEEE Transportation Vehicle Technology, Volume 45 (1996), 276-287. The channel pulse response can be computed, e.g., in the receiver from a received reference signal.

However, interference can also be eliminated in the transmitter if the channel pulse responses are known there. Then the channel pulse response no longer needs to be computed in the receiver. In other words, transmission of a reference signal is then not necessary.

It is also possible to combine transmission systems that have interference elimination in the receiver and systems that have elimination in the transmitter, as is known from Bosch,

"Mixed Use of Joint Predistortion and Joint Detection in the UTRA TDD mode," ETSI Tdoc SMG2 UMTS-L1 205/98.

Because in data transmission systems that support interference elimination both in the receiver and in the transmitter the transmitted reference signal is superfluous when elimination is performed by the transmitter, the transmitted reference signal then occupies transmission capacity unnecessarily. If, when elimination is performed by the transmitter, an individualized transmission format is used, then the corresponding transmission devices are more complex (e.g., as a result of the channel coding designs that become necessary) and/or the data services of the two transmission modes are different.

Advantages of the Invention

The idea underlying the present invention is that the data format for the data to be transmitted in both transmission modes is advantageously selected so as to be identical, and in the mode which does not require a reference signal, in place of this signal, additional redundancy of the data is transmitted.

The method according to the present invention having the features of Claim 1 has the particular advantage that an improvement of the radio link can be achieved in the mode in which no reference signal is required, and moreover at very small additional expense.

In the subclaims can be found advantageous refinements and improvements of the method according to the present invention indicated in Patent Claim 1.

According to one preferred refinement, the redundancy data transmitted in place of the reference signal are provided through data of the data signal that are transmitted in repetition.

According to another preferred refinement, the data transmitted in repetition are received by the receiver in repetition and are evaluated in the receiver separately.

According to another preferred refinement, the data version of the data transmitted in repetition having the larger receiving signal is selected for further processing and/or for

delivery to the user.

According to another preferred refinement, in the second mode, interference is eliminated in the transmitter.

5

According to another preferred refinement, a plurality of data streams are transmitted simultaneously according to the CDMA method.

According to another preferred refinement, the data bursts have at least two data blocks,
10 between which a block is arranged, which in the first mode is used for the reference signal
and in the second mode is used for the redundancy data.

According to another preferred refinement, the data format for the data signals to be transmitted is selected in both transmission modes so as to be identical.

15

Drawings

An exemplary embodiment of the present invention is depicted in the drawing and is discussed in greater detail in the description below.

20

Figure 1a-c depicts a block diagram of a burst structure to explain a specific embodiment of the present invention.

Description of the Exemplary Embodiments

25

In Figure 1a-c, B designates a data burst, t the time, DB1 a first data block, DB2 a second data block, HS an intermediate block for an auxiliary signal, RS a reference signal data block, and RD a redundancy signal data block.

30 The burst structure according to Figure 1a-c is used in a cellular CDMA data transmission system, which operates in time duplex (TDD).

This system has two transmission modes:

- one mode having elimination of interference in the receiver using joint detection in accordance with the teaching of A. Klein, G.K. Kaleh, and P.W. Baier, "Zero Forcing and Minimum Mean-Square-Error Equalization for Multiuser Detection in Code Division Multiple Access Channels," IEEE Transportation Vehicle Technology, Volume 45 (1996), 276-287; and

5 276-287; and

- one mode B having elimination of interference in the transmitter using joint pre-equalization.

10 The data are transmitted between transmitter and receiver in bursts B, which include in each case two data blocks DB1 and DB2 and auxiliary signal data block HS situated in between, as is illustrated in Figure 1a.

The data format for the data signals to be transmitted is selected in both transmission modes so as to be identical.

In mode A, in auxiliary signal data block HS, a reference signal data block RS is transmitted, which is used for computing the channel pulse response in the receiver, as is illustrated in Figure 1b.

20

In mode B, in auxiliary signal data block HS, a reference signal data block RD is transmitted, i.e., additional data redundancy in the form of repeated data symbols, as is illustrated in Figure 1c.

25

Among the multiply transmitted data symbols, the versions having the stronger received signal are selected in the receiver and are further processed (e.g., using a channel decoding), or they are conveyed to the user.

exemplary embodiment, it is not limited thereto, but rather can be modified in many ways.

30 exemplary embodiment, it is not limited thereto, but rather can be modified in many ways.

In particular, the method according to the present invention can be used in all data transmission systems which use both a transmission mode which requires the transmission of

a reference signal as well as a transmission mode which does not require a reference signal, and it is not limited to CDMA data transmission systems.

In addition, any criterion for the selective further processing or delivery of the redundancy data can be used.

What is claimed is:

1. A data transmission method in which a data signal is transmitted between transmitter and receiver in the form of a data stream of data bursts (B) in at least two transmission modes, in the first mode a reference signal (RS) being transmitted by the transmitter in each data burst (B) and being evaluated in the receiver, and in the second mode no reference signal (RS) being transmitted by the transmitter in each data burst (B),
wherein, in the second mode, in place of the reference signal (RS), additional redundancy data (RD) of the data signal are transmitted in each data burst (B).
2. The method as recited in Claim 1,
wherein the redundancy data (RD) transmitted in place of the reference signal (RS) are provided by data of the data signal that are transmitted in repetition.
3. The method as recited in Claim 2,
wherein the data transmitted in repetition are received in repetition by the receiver and are evaluated separately in the receiver.
4. The method as recited in Claim 3,
wherein the data version of the data transmitted in repetition having the larger received signal is selected for further processing and/or delivery to the user.
5. The method as recited in one of Claims 1 through 4,
wherein, in the second mode, interference is eliminated in the transmitter.
6. The method as recited in one of Claims 1 through 5,
wherein a plurality of data streams are transmitted simultaneously according to the CDMA method.
7. The method as recited in one of the preceding claims,
wherein the data bursts (B) have at least two data blocks (DB1, DB2), between which a block is arranged which is used, in the first mode, for the reference signal (RS), and which is used, in the second mode, for the redundancy data (RD).

8. The method as recited in one of the preceding claims,
wherein the data format for the data signals to be transmitted is selected in both transmission
modes so as to be identical.

Abstract

The present invention creates a data transmission method in which a data signal is transmitted between transmitter and receiver in the form of a data stream of data bursts (B) in at least two transmission modes, in the first mode a reference signal (RS) being transmitted by the transmitter in each data burst (B) and being evaluated in the receiver, and in the second mode no reference signal (RS) being transmitted by the transmitter in each data burst (B). In the second mode, in place of the reference signal (RS), additional redundancy data (RD) of the data signal are transmitted in each data burst (B).

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(Figure 1)

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FIG 1a

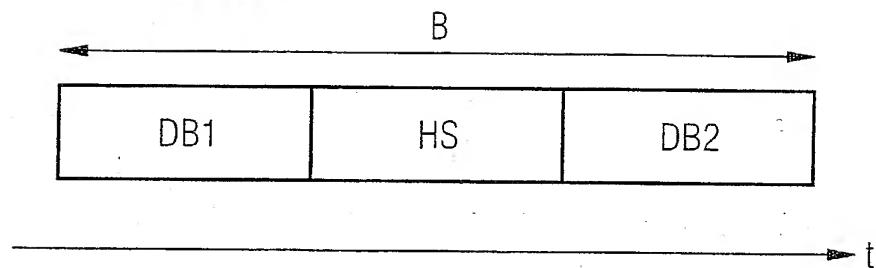


FIG 1b

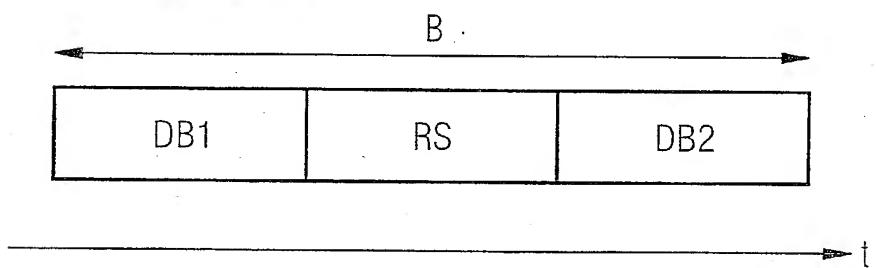
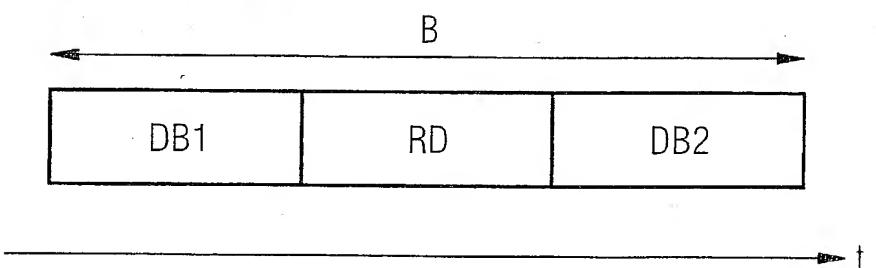


FIG 1c



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**COMBINED DECLARATION AND
POWER OF ATTORNEY FOR PATENT APPLICATION**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below adjacent to my name.

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **DATA TRANSMISSION METHOD**, and the specification of which:

is attached hereto;

was filed as United States Application Serial No. _____ on _____, 19____ and was amended by the Preliminary Amendment filed on _____, 19____.

was filed as PCT International Application Number PCT/DE00/03416 on the 28th day of September, 2000.

an English translation of which is filed herewith.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a). I hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international applications(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

EL 828245668 US

**PRIOR FOREIGN/PCT APPLICATION(S)
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119**

Country : Federal Republic of Germany

Application No. : 199 46 866.4

Date of Filing: September 30, 1999

Priority Claimed

Under 35 U.S.C. § 119 : [X] Yes [] No

I hereby claim the benefit under Title 35, United States Code § 120 of any United States Application or PCT International Application designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations § 1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

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DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. § 120**

U.S. APPLICATIONS

Number :

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**PCT APPLICATIONS
DESIGNATING THE U.S.**

PCT Number :

PCT Filing Date :

34003633635 303217002

I hereby appoint the following attorney(s) and/or agents to prosecute
the above-identified application and transact all business in the Patent and Trademark
Office connected therewith.

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